

Chapter Eight

Basic Concepts of Chemical Bonding

1. The correct electron-dot formulation for hydrogen cyanide (HCN) shows:

- (a) 2 double bonds and two lone pairs of electrons on the N atom.
- (b) 1 C-H bond, 1 C=N bond, 1 lone pair of electrons on the C atom and 1 lone pair of electrons on the N atom.
- (c) 1 C-H bond, 1 C-N bond, 2 lone pairs of electrons on the C atom and 3 lone pairs of electrons on the N atom.
- (d) 1 triple bond between C and N, 1 N-H bond and 2 lone pairs of electrons on the C atom.
- (e) 1 triple bond between C and N, 1 C-H bond and 1 lone pair of electrons on the N atom.

2. The correct dot formulation for nitrogen trichloride (NCl_3) has:

- (a) 3 N-Cl bonds and 10 lone pairs of electrons.
- (b) 3 N=Cl bonds and 6 lone pairs of electrons.
- (c) 1 N-Cl bond, 2 N=Cl bonds and 7 lone pairs of electrons.
- (d) 2 N-Cl bonds, 1 N=Cl bond and 8 lone pairs of electrons.
- (e) 3 N-Cl bonds and 9 lone pairs of electrons.

3. What is the total number of electrons in the correct Lewis dot formula of the sulfite ion (SO_3^{2-})?

- (a) 8
- (b) 24
- (c) 26
- (d) 30
- (e) 32

4. In the Lewis structure for the OF_2 molecule, the number of lone pairs of electrons around the central oxygen atom is

- (a) 0
- (b) 1
- (c) 2
- (d) 3
- (e) 4

5. The electronic structure of the SO_2 molecule is best represented as a resonance hybrid of _____ equivalent structures.

- (a) 2
- (b) 3
- (c) 4
- (d) 5
- (e) This molecule does not exhibit resonance.

6. Draw one of the resonance structures of SO_3 . The formal charge of S is

- (a) +2
- (b) +1
- (c) 0
- (d) -1
- (e) -2

7. Which one of the following violates the octet rule?

- (a) PCl_3
- (b) CBr_4
- (c) NF_3
- (d) OF_2
- (e) AsF_5

8. The lattice energy of LiF is 1037 kJ/mol. This energy corresponds to which reaction below?

- (a) $\text{LiF}_{(s)} \rightarrow \text{Li}_{(s)} + 1/2 \text{ F}_{2(g)}$
- (b) $\text{LiF}_{(s)} \rightarrow \text{Li}_{(g)} + \text{F}_{(g)}$
- (c) $\text{LiF}_{(s)} \rightarrow \text{Li}^+_{(g)} + \text{F}^-_{(g)}$
- (d) $\text{LiF}_{(g)} \rightarrow \text{Li}_{(g)} + \text{F}_{(g)}$

9. Which of the following bonds is most polar?

- (a) N–Cl
- (b) B–F
- (c) Si–Br
- (d) C–H

10. What is the formal charge on each atom in the hypochlorite ion, OCl^- ?

- (a) O = +1, Cl = -2
- (b) O = -1, Cl = 0
- (c) O = 0, Cl = -1
- (d) O = -1, Cl = +1

11. A covalent double bond contains how many electrons?

- (a) 1
- (b) 3
- (c) 2
- (d) 4

12. Which compound below contains the most polar bond?

- (a) Cl₂
- (b) MgS
- (c) NaCl
- (d) FrF

13. How many single and double bonds are in the most stable resonance structure of NO_3^- ?

- (a) 3 single bonds, 0 double bond
- (b) 1 single bond, 2 double bonds
- (c) 0 single bond, 3 double bonds
- (d) 2 single bonds, 1 double bond

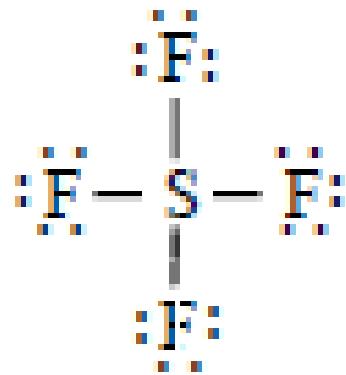
14. What are the formal charges on O, N, and Cl in the Lewis structure below? Only the bonds are shown; lone pairs are not shown. O=N=Cl

- (a) O = -1; N = 0; Cl = +1
- (b) O = -1; N = +1; Cl = -2
- (c) O = +1; N = -1; Cl = 0
- (d) O = -1; N = +2; Cl = -1

15. When drawing Lewis structures, which one of the following compounds violates the octet rule?

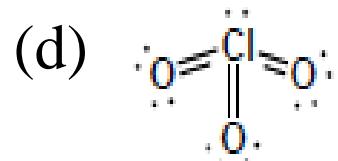
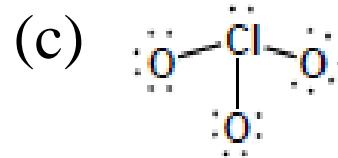
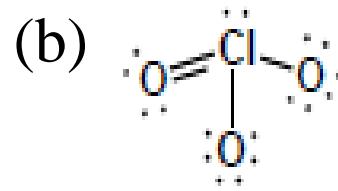
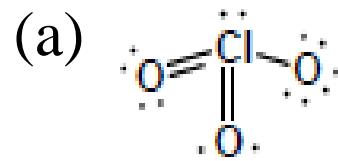
- (a) CO₂
- (b) NO
- (c) NH₄⁺
- (d) N₂

16. What is wrong with the structure of SF_4 below, if anything?

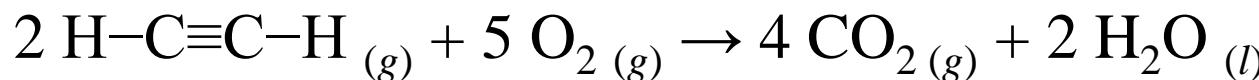


- (a) The Lewis structure is correct.
- (b) There should be a lone pair of electrons on S.
- (c) There should be a double bond between S and F.
- (d) One of the F atoms should be the central atom in order to have the correct formal charges.

17. Using formal charges, which one of the following Lewis structures is correctly drawn for the ClO_3^- ion?



18. Using average bond energies, calculate ΔH_{rxn} for the combustion of acetylene, shown in the reaction below.



Bond	Bond Energy (kJ/mol)
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C–H	414
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C–C	347
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C≡C	837
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O=O	498
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C=O	799
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O-H	464
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(a) -1500 KJ

(b) -3256 KJ

(c) -2428 KJ

(d) -4918 KJ

Practice Exercise

The dipole moment of chlorine monofluoride, $\text{ClF}(g)$, is 0.88 D. The bond length of the molecule is 1.63 Å.

- (a) Which atom is expected to have the partial negative charge?
- (b) What is the charge on that atom in units of e ?